CLAIMS

Having thus described our invention, what we claim as new and desire to secure by the Letters Patent is:

1. A ferroelectric capacitor comprising a conductive electrode layer; a ferroelectric layer disposed on said conductive electrode layer; a conductive counterelectrode layer formed on said ferroelectric layer and an at least partially decomposed oxygen source layer in proximity to one of said electrode layers.

2. The ferroelectric capacitor of Claim 1 wherein said conductive electrode layer and said conductive counterelectrode layer are composed of the same or different conductive material selected from the group consisting of noble metals, noble metal oxides, conductive oxides and mixtures and multilayers thereof.

3. The ferroelectric capacitor of Claim 1 wherein said ferroelectric layer is a perovskite-type oxide, a compound containing a pyrochlore structure, a potassium dihydrogen phosphate, phosphates of rubidium, cesium or arsenic and mixtures or multilayers thereof.

4. The ferroelectric capacitor of Claim 3 wherein said perovskite-type oxide has the formula ABO_3 wherein B is at least one acidic oxide containing a metal from Group IVB,

VB, VIB, VIIB, IIIA or IB of the Periodic Table of Elements, and A is an additional cation having a positive formal charge of from about 1 to about 3.

5. The ferroelectric capacitor of Claim 4 wherein said perovskite-type oxide is a titanate-based ferroelectric, a manganate-based material, a cuprate-based material, a tungsten-bronze niobate, tantalate or titanate, or a bismuth layered-tantalate, niobate or titanate.

6. The ferroelectric capacitor of Claim 5 wherein said perovskite-type oxide is strontium bismuth tantalate, strontium bismuth niobate, bismuth titanate, strontium bismuth tantalate niobate, lead zirconate titanate, lead lanthanum zirconate and compositions thereof modified by a dopant material.

7. The ferroelectric capacitor of Claim 1 wherein said oxygen source layer is a metal oxide having the formula MO_x wherein M is a noble metal, a non-noble metal or mixtures and alloys thereof and x is from about 0.03 to about 3.

8. The ferroelectric capacitor of Claim 1 further comprising additional conductive layers proximate to said electrode, counterelectrode, or oxygen source layer, wherein said additional conductive layer is a material selected from the group consisting of noble metals, noble metal oxides, conductive oxides, metal nitrides, metal

silicon nitrides, metal oxides, metal oxynitrides and mixtures or multilayers thereof.

9. The ferroelectric capacitor of Claim 1 further comprising one or more dielectric layers formed on the uppermost layer of the capacitor.

10. The ferroelectric capacitor of Claim 1 wherein said conductive electrode layers are patterned or non-patterned.

11. The ferroelectric capacitor of Claim 1 wherein said oxygen source layer is patterned or non-patterned.

12. The ferroelectric capacitor of Claim 1 wherein said at least partially decomposed oxygen source layer and said electrode layer are patterned, said patterned oxygen source layer is under patterned electrode layer, and said ferroelectric layer is disposed so as to contact both top and side surfaces of said patterned electrode layer, and side surfaces of said patterned oxygen source layer.

13. The ferroelectric capacitor of Claim 1 wherein said structure is planar or non-planar.

14. The ferroelectric capacitor of Claim 1 wherein said ferroelectric layer is replaced by a layer of high-epsilon material having a dielectric constant of 20 or above.

15. An integrated ferroelectric/CMOS structure comprising:

a CMOS structure having at least one transistor;

a ferroelectric capacitor formed on said CMOS structure, said ferroelectric capacitor comprising a conductive electrode layer, a ferroelectric layer disposed on said conductive electrode layer, a conductive counterelectrode layer formed on said ferroelectric layer and an at least partially decomposed oxygen source layer in proximity to one of said electrode layers; and

at least one wiring level formed on said ferroelectric capacitor.

16. The integrated ferroelectric/CMOS structure of Claim 15 wherein said CMOS structure further includes at least one wiring level formed over a semiconductor substrate.

17. The integrated ferroelectric/CMOS structure of Claim 16 wherein said semiconductor substrate is a semiconducting material selected from the group consisting of Si, Ge, SiGe, GaAs, InAs, InP, other III/V compounds and organic semiconductors.

18. The integrated ferroelectric/CMOS structure of Claim 15 wherein said conductive electrode layer and said conductive counterelectrode layer are composed of the same

or different conductive material selected from the group consisting of noble metals, noble metal oxides, conductive oxides and mixtures and multilayers thereof.

19. The integrated ferroelectric/CMOS structure of Claim 15 wherein said ferroelectric material is a perovskite-type oxide, a compound containing a pyrochlore structure, a potassium dihydrogen phosphate, phosphates of rubidium, cesium or arsenic and mixtures or multilayers thereof.

20. The integrated ferroelectric/CMOS structure of Claim 19 wherein said perovskite-type oxide has the formula ABO_3 wherein B is at least one acidic oxide containing a metal from Group IVB, VB, VIB, VIIB, IIIA or IB of the Periodic Table of Elements, and A is an additional cation having a positive formal charge of from about 1 to about 3.

21. The integrated ferroelectric/CMOS structure of Claim 20 wherein said perovskite-type oxide is a titanate-based ferroelectric, a manganate-based material, a cuprate-based material, a tungsten-bronze niobate, tantalate or titanate, or a bismuth layered-tantalate, niobate or titanate.

22. The integrated ferroelectric/CMOS structure of Claim 21 wherein said perovskite-type oxide is strontium bismuth tantalate, strontium bismuth niobate, bismuth titanate, strontium bismuth tantalate niobate, lead zirconate

titanate, lead lanthanum zirconate and compositions thereof modified by a dopant material.

23. The integrated ferroelectric/CMOS structure of Claim 15 wherein said oxygen source layer is a metal oxide having the formula MO_x wherein M is a noble metal, a non-noble metal or mixtures and alloys thereof and x is from about 0.03 to about 3.

24. The integrated ferroelectric/CMOS structure of Claim 15 further comprising additional conductive layers proximate to said electrode, counterelectrode, or oxygen source layer, wherein said additional conductive layer is a material selected from the group consisting of noble metals, noble metal oxides, conductive oxides, metal nitrides, metal silicon nitrides, metal oxides, metal oxynitrides and mixtures or multilayers thereof.

25. The integrated ferroelectric/CMOS structure of Claim 15 wherein said conductive electrodes are patterned or non-patterned.

26. The integrated ferroelectric/CMOS structure of Claim 15 wherein said oxygen source layer is patterned or non-patterned.

27. The integrated ferroelectric/CMOS structure of Claim 15 wherein said at least partially decomposed oxygen source layer and said electrode layer are patterned, said patterned oxygen source layer is under patterned electrode layer, and said ferroelectric layer is disposed so as to contact both top and side surfaces of said patterned electrode layer, and side surfaces of said patterned oxygen source layer.

28. The integrated ferroelectric/CMOS structure of Claim 15 wherein said wiring levels include at least one conductive layer and at least one dielectric layer.

29. The integrated ferroelectric/CMOS structure of Claim 15 wherein said ferroelectric capacitor is planar or non-planar.

30. The integrated ferroelectric/CMOS structure of Claim 15 wherein said ferroelectric layer is replaced with a layer of high-epsilon material having a dielectric constant of 20 or greater.

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31. A method of fabricating an integrated ferroelectric/CMOS structure comprising the steps of:

(a) forming at least one complementary metal oxide semiconductor (CMOS) device on a semiconductor wafer;

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(b) forming a ferroelectric capacitor over said CMOS device, said ferroelectric capacitor comprising at least a ferroelectric layer and an oxygen source layer in proximity to a conductive electrode layer, wherein said oxygen source layer is capable of at least partially decomposing at temperatures below 700°C;

(c) forming wiring levels on said ferroelectric capacitor at temperatures below 450°C; and

(d) annealing the structure at a temperature between 300°C and 700°C so as to at least partially decompose the oxygen source layer to release oxygen into the ferroelectric capacitor.

32. The method of Claim 31 wherein said CMOS device includes a transistor region and a semiconductor substrate.

33. The method of Claim 32 wherein said semiconductor substrate is a semiconducting material selected from the group consisting of Si, Ge, SiGe, GaAs, InAs, InP, other III/V compounds and organic semiconductors.

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34. The method of Claim 31 wherein said conductive electrode layer and said conductive counterelectrode layer are composed of the same or different conductive material selected from the group consisting of noble metals, noble metal oxides, conductive oxides and mixtures and multilayers thereof.

35. The method of Claim 31 wherein said ferroelectric material is a perovskite-type oxide, a compound containing a pyrochlore structure, a potassium dihydrogen phosphate, phosphates of rubidium, cesium or arsenic and mixtures or multilayers thereof.

36. The method of Claim 35 wherein said perovskite-type oxide has the formula ABO_3 wherein B is at least one acidic oxide containing a metal from Group IVB, VB, VIB, VIIB, IIIA or IB of the Periodic Table of Elements, and A is an additional cation having a positive formal charge of from about 1 to about 3.

37. The method of Claim 36 wherein said perovskite-type oxide is a titanate-based ferroelectric, a manganate-based material, a cuprate-based material, a tungsten-bronze niobate, tantalate or titanate, or a bismuth layered-tantalate, niobate or titanate.

38. The method of Claim 37 wherein said perovskite-type oxide is strontium bismuth tantalate, strontium bismuth niobate, bismuth titanate, strontium bismuth tantalate niobate, lead zirconate titanate, lead lanthanum zirconate and compositions thereof modified by a dopant material.

39. The method of Claim 3~~4~~6 wherein said oxygen source layer is a metal oxide having the formula MO_x wherein M is

a noble metal, a non-noble metal or mixtures and alloys thereof and x is from about 0.03 to about 3.

40. The method of Claim 31 wherein said conductive electrodes are patterned or non-patterned.

41. The method of Claim 31 wherein said oxygen source layer is patterned or non-patterned.

42. The method of Claim 31 wherein said annealing step is carried out at a temperature of from about 350° to about 700°C for a time period of from about 1 minute to about 4 hours.

43. The method of Claim 42 wherein said annealing step is carried out at a temperature of from about 350° to about 500°C for a time period of from about 1 minute to about 10 minutes.

44. The method of Claim 31 wherein said annealing step is carried out in an inert gas atmosphere that may optionally be mixed with an oxidizing gas.

45. The method of Claim 31 wherein said ferroelectric capacitor is planar or non-planar.

46. The method of Claim 31 wherein the annealing step is replaced by the step of allowing said oxygen source layer

to decompose during steps selected from the group of ferroelectric deposition, top electrode deposition, optional encapsulant deposition, BEOL process and device operation.

47. The method of Claim 31 wherein said ferroelectric layer of said ferroelectric capacitor is replaced with a high-epsilon layer having a dielectric constant of 20 or greater.

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